EXHIBIT S

Nicolas Andreoulis, *Economics of Seigniorage – The Case of Chai*, February 2020.

EXHIBIT S

Economics of Seigniorage - The Case of Chai

Nicolas Andreoulis

February 2020

1 Introduction

To understand how dApps like Chai contribute to Terra's economy, we should explore the economics of seigniorage.

Seigniorage is defined as the increase in Terra supply, minus the cost of issuing new Terra, subject to the constraint that the price level (relative to the underlying fiat currency) remains constant. Seigniorage is the highest, when money injections are maximised while keeping the peg stable.

To see, how everything links together, lets just focus on KRT and start with the Fisher Equation of Exchange, which says that at any point in time the following has to hold:

$$\text{Price}_t \cdot \text{Output}_t = \text{Money}_t \cdot \text{Velocity}_t$$

This equation states that nominal output (ie the aggregate value of all transactions), has to be equal to all the tokens in circulations, times their velocity (the amount that an average token changes hands in a given period). Since KRT is a pegged coin, the above values, technically should be considered in relative terms to the Korean Economy. But since the volatility in the token economy is orders of magnitude larger, we can assume that the vast majority of the deviations comes from changes in the Terra economy.

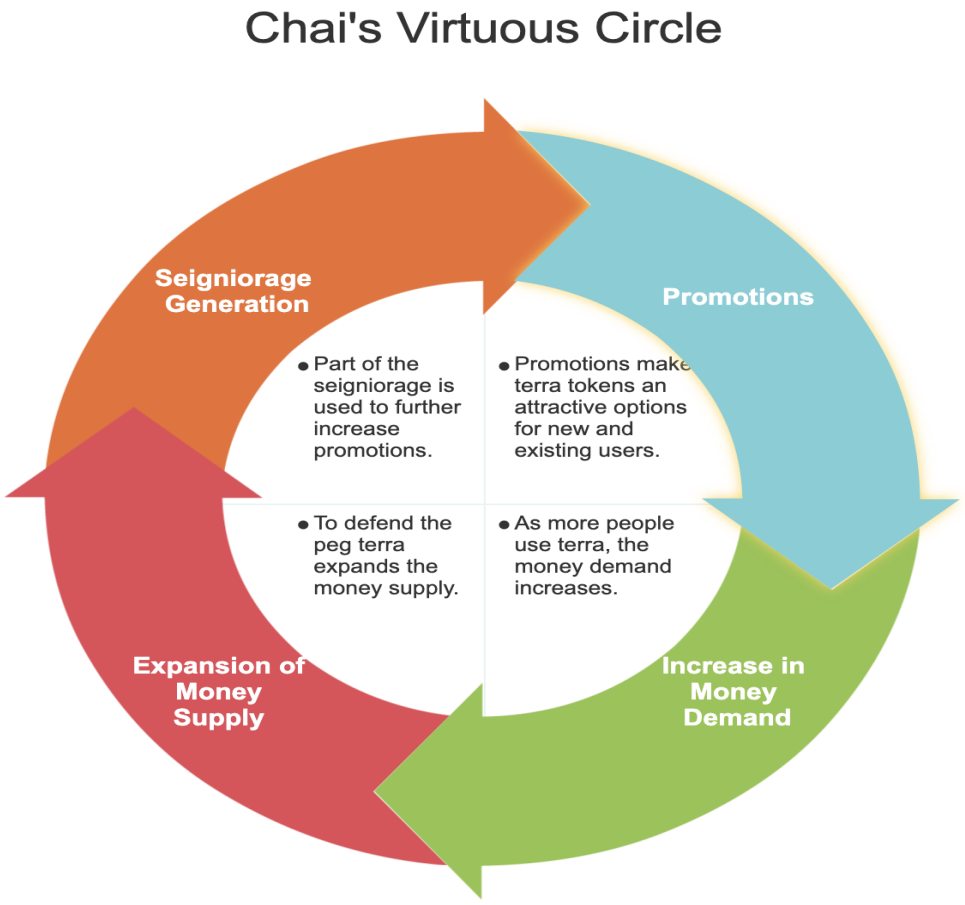
2 Seigniorage and Chai

As of now, Chai represents the majority of Terra's Economy, so it's worth exploring the above framework through the lens of Chai. Chai operates in the following way. Users transfer funds from their bank account, and through Chai access KRT to purchase goods and services from various merchants. Chai has a settlement period, which is to say that merchants don't instantly convert their tokens receipts to fiat. The settlement period is at least 14 days but varies from merchant to merchant.

By using Terra, Chai generates seigniorage, which in turn gives funding to benefits for both consumers and merchants. For the peg to not break, injections of seigniorage (ie the increase in the supply of money), have to be met by an equal increase in the demand for money. This is to say that within the settlement period, either transaction volume is increasing or velocity is declining.

3 Economic Growth

Chai's user base has exploded in the last few months. From June to February it's compounded week to week growth is close to 10% and it recently exceeded one million users. This is reflected with a large increase in transaction volume, with a compounded week to week growth of about 8%. The growth in transaction volume, has translated to a steady increase in demand for KRT. This allows Terra to mint more KRT tokens, which Chai receives in the form of seigniorage to fund promotions, which further increase the demand of Terra creating a virtuous circle.



It has to be noted that the above scenario only refers to the upside. If however, there is a big decrease in demand there are tools at place to promote stability. First of all Luna, whose market cap exceeds KRT and has a countercyclical reward structure can be used as an effective collateral to buyback any excess KRT in circulation. Secondly, Terraform Labs has collected sufficient cash buffers, that could be used in a situation of dire need. All of the above guarantee that KRT can trade closely to the peg under most economic environments [1].

[1] An additional indication of the system's robustness is that the KRT/KRW pair has never diverged for more than 1%.

4 Velocity

Although growth is important, it's not the only driver of seigniorage growth. Velocity is one of the main determinants of how changes in the money supply affect the price level (or the peg). That relationship is based on the simple fact that the lower the velocity, the longer people hold their money rather than redeeming them. In the extreme scenario of zero velocity, people never exchange their tokens for fiat (in Chai's case this would translate to an infinite settlement period), so money supply can increase unboundedly without any impact on the peg. This is an extremely important feature, due to the fact that even if transaction volume grows at a slow rate, as long as Chai somehow achieves a decrease in velocity, seigniorage can be generated to fund additional promotions. Two Chai developments have achieved a significant slowdown of velocity. First of all, the promotion structure of Chai has largely moved from discounts to cashbacks. This ensures that as long as cashbacks are not being exchanged instantly, tokens stay within the Terra economy for a longer period, therefore velocity slows down. Secondly, Chai has introduced topups, which incentivizes users to auto-top up their accounts with KRT, which leads to 1) the creation of a demand floor for Terra, 2) a significant slowdown of velocity, since people tend to have an unused balance of KRTs at all times. To illustrate that point is worth noticing the trend of the aggregate net balance of KRTs within Chai. Since the launch of the topups scheme less than three months ago, KRT deposited on user's accounts have increased by a whooping 2400%.

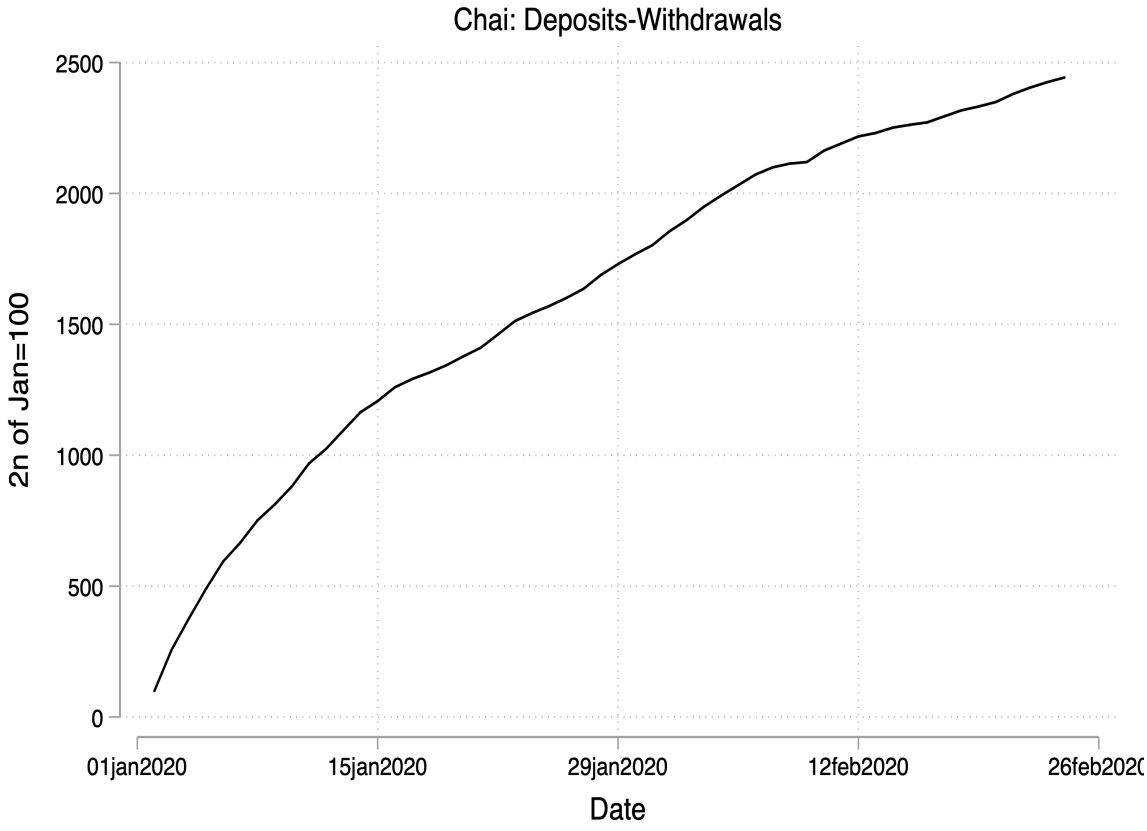


Figure 1: Balance is defined as the net inflow (deposits) - net outflow (KRT used for purchases or withdrawed).

5 Final Thoughts

As of now Chai represents the majority of the Terra's economy. The economics of Chai, have allowed the generation of significant seigniorage, which has funded ongoing benefits to consumers and merchants. A caveat of the current setup however, is that Terra is exposed to Korea, Chai and merchant specific risks. There are two definitions of risk. Systemic risk, refers to aggregate factors and trends that are broad and impact the whole market (think of natural disasters, political changes, pandemics etc.). Such outcomes, impact all market participants, cannot easily be mitigated and are inherent to all economies. Idiosyncratic risk refers to events that are specific to a particular company and not the market as a whole. Such risks can and should be mitigated through diversification. There are many active efforts to diversify the Terra Ecosystem. Chai is expanding it's partner base, with significant integrations in the near future. The launch of Chai card will vastly increase access to the Terra ecosystem and reduce reliance to specific merchants. Meme Pay in Mongolia although small in scale has been our first successful step outside of Korea and the international expansion of Terra is on the works. The last missing ingredient is a more active community participation. For Terra to truly succeed at becoming the future of money, diversification has to happen at all levels. We are eager to support dApps developing from within the community, with multiple use-cases, spawning all geographies. The most efficient allocation of resources is achieved in a decentralized fashion through spontaneous order. Only then sustainable demand growth and seigniorage will keep growing at an unparalleled rate.